

Sensors

Acoustic Beamforming Array

An acoustic beamforming array using feedback-controlled microphones for tuning and self-matching of frequency response

NASA Langley Research Center in collaboration with Michigan State University (MSU) has developed a microphone array that identifies the locations and strengths of acoustic sources using sensors that are "self-calibrated" with closed-loop feedback control. This results in an array that can be considered "self-matching." Beamforming microphone arrays typically consist of tens to hundreds of microphones. The location of an acoustic source can be determined by exploiting the acoustic wave propagation delays from the source to each of the microphones. For the system to be accurate each microphone must be calibrated to account for varying magnitude and phase frequency responses. Manual calibration is time-consuming and may need to be repeated regularly to take into account effects such as heat and humidity. The NASA Langley / MSU innovation removes such time-consuming calibration and provides more accurate results.

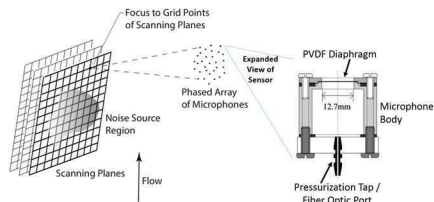
BENEFITS

- Self-matching feedback control greatly simplifies pre-test acoustic calibrations of the microphone array and reduces the need for subsequent calibrations
- High accuracy - increased accuracy due to precisely matched feedback control

technology solution

THE TECHNOLOGY

This invention uses microphones that are "self-calibrated" using electrical actuation, and feedback control that "self-matches" the frequency response of each microphone in the array based on user specifications. NASA Langley and Michigan State University have developed and tested a microphone prototype using a thin polyvinylidene fluoride (PVDF) film membrane, which allows for actuation in a feedback scheme. The feedback actively modifies such sensor parameters as membrane stiffness, resonant frequency, damping, and DC attenuation. A fiber-optic sensor was used to detect displacement of the membrane's center caused by acoustic pressure. The feedback response was verified as closely matching what was predicted.



Microphone Phased Array Operation with Sensor Details

APPLICATIONS

The technology has several potential applications:

- ➡ Aeroacoustics Research
- ➡ Jet Noise Research
- ➡ Military
- ➡ Remote Sensing

PUBLICATIONS

Patent No: 8,848,942

Radcliffe, E., Naguib, A., and Humphreys, W. M., Jr., A novel design of a feedback-controlled optical microphone for aeroacoustics research, *Measurement Science and Technology*, Vol. 21 (2010).

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